Analysis of pigment palettes as evidence for room status in Nero’s Golden House
Emma Payne and Dirk Booms

SUMMARY The British Museum holds a group of 12 Roman wall painting fragments from the emperor Nero’s palace in Rome, the Domus Aurea or ‘Golden House’. They were discovered around 1850 by the owner of a vineyard whose land sat atop the ruins, then primarily known as the decorated caves that inspired the grotesques painted by Raphael and other Renaissance artists. Brief analysis of the fragments in the 1980s verified the presence of high-quality gold leaf and the expensive red pigment, cinnabar. The selection of one of the pieces for display in the UK touring exhibition Roman Empire: Power and People (2013–2015) prompted conservation and further research of the entire group. The paintings display rich use of shade and texture through stucco modelling and impasto paint. Optical microscopy, X-ray fluorescence spectroscopy and visible-induced luminescence imaging enabled closer investigation of the materials used to decorate the original surface. These revealed additional remnants of gold leaf and extensive application of cinnabar and Egyptian blue in some of the paintings, while others contained less expensive pigments. The findings enhance the understanding of the historical context of the paintings by confirming the visual distinctions already made between styles of paintings from different rooms and demonstrating that the hierarchy between rooms dictated the selection of materials.

Introduction
In 1908, the British Museum purchased a collection of Roman wall paintings from the emperor Nero’s Domus Aurea or ‘Golden House’. Analysis of the visible remnants of gold leaf and of some of the pigments was conducted in 1983–1984 [1]. When one of the fragments was selected for inclusion in the UK touring exhibition Roman Empire: Power and People (2013–2015), the entire group was investigated more thoroughly and re-conserved, since many of the pieces had become obscured by dirt and the yellowing of a thick varnish. This contribution discusses the conservation of the wall paintings, as well as the wide range of pigments discovered, analysis of which has helped to identify two distinct palettes of pigments. These analytical findings confirm visual distinctions already made between the painting styles of different rooms in the Domus Aurea, and specifically between the two rooms from which the British Museum paintings are thought to come: the first of which was painted rather perfunctorily (Corridor 92), and the other more intricately (Room 119). The aim of the comparison is to demonstrate any link between the hierarchy of the rooms and the materials selected for their decoration.

Acquisition
On 28 June 1907, the British Museum was contacted by Frederick Swynnerton, Esq., regarding “some pieces of ancient Roman wall”. In a letter, Mr Swynnerton related how he had purchased these fragments in Rome 20 years earlier:

Sir, I have in my possession some pieces of ancient Roman painted wall. They were sold to me in Rome twenty years ago by a man who had a vineyard on the Esquiline near the Baths of Titus. From his vineyard, he found access to a subterranean chamber, & took away these specimens of the painted decorations he found there. They are bits of ceiling + wall ornamented with arabesques + griffins, and several among them bear out the statement that Raphael got his ideas for the decoration of some of the Vatican loggias from the ancient arabesques in the Baths.
of Titus. It may be however that as these were below the surface they belonged to the Golden House of Nero. There are about a dozen fragments, – the largest – with two griffins – about two feet long, and the paintings on some are very well preserved. – I wish to dispose of these relics and I should like to hear from you as to whether it would be worth my while bringing them to you for your interpretation. The paintings themselves will at once convince you of their antiquity.

At first, the Department of Greek and Roman Antiquities showed little interest; a note by a curator reads: “Prob[ably] no use to us: but if he likes to send photos or specimens, can do”. The fragments arrived, accompanied by a second letter, in which Mr Swynnerton dated their discovery by the vineyard’s owner to “about 1850”. Yet the department remained unenthusiastic, as a second note from 16 January 1908 indicates:

“Most are frag[men]ts and poor style. Would he sell some of the large frag[men]ts, + if so, what price?” Ultimately, a price of £10 for all 12 pieces was settled upon and the purchase was finalized in April 1908 [2; 1560k, 1560l and 1560m, 3; p. 119, 4; p. 90].

Frederick Swynnerton was one of five brothers, including the Reverend Charles Swynnerton, chaplain with the Indian army, a fellow of the Society of Antiquaries of London and a writer of Indian folk tales [5], and the sculptor Joseph William Swynnerton, who was married to the painter Annie Louise Robinson, the first woman to be elected to the Royal Academy [6]. Frederick, who was also a painter of some distinction [6], was elected a fellow of the Society of Antiquaries of London and lectured on the prehistoric remains on the Isle of Man [7]. It may be that the combination of his profession as a painter and his interest in archaeology prompted him to buy these wall painting fragments during a stay in Rome.

Table 1. Summary of the wall painting fragments from the Domus Aurea and the occurrence of pigments and gold

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Room</th>
<th>Gold</th>
<th>Cinnabar</th>
<th>Red ochre/ red lead</th>
<th>Egyptian blue</th>
<th>Green earth</th>
<th>Copper-based green</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pair of sea monsters flanking a mask; a line of flowers marks the lower edge of the scene (Figure 2)</td>
<td>Corridor 92</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓</td>
</tr>
<tr>
<td>2</td>
<td>Part of a horizontal panel showing acanthus plants and flowers with hanging pods or fruit (Figure 9)</td>
<td>Room 119</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓</td>
</tr>
<tr>
<td>3</td>
<td>Vertical panel decorated with a candelabrum in the form of tiers of acanthus. The candelabrum is decorated with a three-stringed lyre and busts of two sphinxes</td>
<td>Room 119</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓</td>
</tr>
<tr>
<td>5a</td>
<td>Part of a frieze showing a pair of sphinxes among acanthus plants. Stucco figures within the open flowers represent Leda awaiting the swan (Figures 6, 7 and 8)</td>
<td>Room 119</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓</td>
</tr>
<tr>
<td>11</td>
<td>Part of a horizontal border decorated with tendrils and rosettes</td>
<td>Room 119</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓</td>
</tr>
<tr>
<td>12</td>
<td>Vertical panel decorated with a candelabrum of acanthus. The candelabrum bears a pair of swans and a pair of sphinxes</td>
<td>Room 119</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓</td>
</tr>
<tr>
<td>13</td>
<td>Vertical panel decorated with a candelabrum of acanthus from which springs a pair of sphinxes</td>
<td>Room 119</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓</td>
</tr>
<tr>
<td>14</td>
<td>Vertical panel decorated with a candelabrum of acanthus. One of a pair of decorative swans survives at the lower edge of the fragment (Figure 10)</td>
<td>Room 119</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓✓</td>
<td>✓</td>
<td>✓✓</td>
</tr>
</tbody>
</table>

Notes:

a In the areas tested red ochre and red lead were present only in a mixture with cinnabar.

b Fragment No. 5 was not examined using pXRF as it was part of the UK tour of Roman Empire: Power and People when the analysis was conducted. The identification of the pigments is based on VIL imaging and comparison of the observations made under the microscope with those for other fragments.
Frederick correctly identified the pieces as coming from the Domus Aurea, the grand villa complex that the emperor Nero built in the centre of Rome after the devastating fire of AD 64 [8; Nero XXXI, 9; book 15 XLII], and which according to Pliny the Elder was painted by one Famulus/Fabullus [10; book 35 CXX]. Part of that villa, more precisely a complex of luxuriously decorated rooms known as the Esquiline wing, was deliberately built over by the emperor Trajan by the construction of his eponymous baths, which were still incorrectly referred to as the ‘Baths of Titus’ in Swynnerton’s time. Although the wall paintings failed to impress the curators at the British Museum in the early nineteenth century, by 1913 the fragments were included in a still-important article on the Domus Aurea, in which for the first time, the whole complex was systematically treated, using information from a wide range of sources, including new excavations in recently discovered rooms [11].

The wall paintings

The British Museum group comprises 12 fragments ranging in size from approximately 15 × 15 cm to 26 × 67 cm. They are registered under museum numbers 1908,0417.1–3, 5–6, 8, 10–14 and 16. Throughout the text, the fragments are referred to using the final number in the sequence; see Table 1 for a brief description of each panel. Their subject matter consists primarily of brightly coloured repetitive decorative frizes with floral and mythological themes; images for each fragment can be found on the British Museum Collections Online database.

In 1913, Weege identified the fragments as coming from Corridor 92, the long central cryptoporticus of the Esquiline wing, of which only the western half was fully excavated at that time, Figure 1: it should be noted that before Fabbrini’s renumbering [12], Corridor 92 had been referred to as Room 70. Weege observed strong parallels in the motifs, but these apply only to fragments 1, 6, 8, 10 and 16. The motifs on the remaining fragments were more recently related to those on the upper parts of the walls and the fluted half-dome in Room 119 (the so-called Hall of Achilles).

Corridor 92 has long been known to be one of the famous caves or ‘grottoes’ that inspired Renaissance artists, including Raphael, towards the ‘grotesques style’. Both the sea monsters flanking a Medusa head (No. 1: Figure 2) and the Pegasus (No. 8: Figure 3) feature in a drawing by Giuliano da Sangallo [11; p. 189, fig. 34]. A common practice among early explorers was to write their names and dates on the plastered walls and fragments 6 and 10, attributed to this corridor, show the remains of Renaissance graffiti, Figure 4. In contrast, Frank Salmon has shown that Room 119 was only discovered by the Neo-Classical architect Charles Cameron in 1768 and seemingly remained closed off and unexplored – apart from the vineyard owner’s visit – until after Weege’s article (which places the room in an ‘unexcavated’ zone), as evidenced by its systematic misorientation in maps made between Cameron’s discovery and Giuseppe Lugli’s 1924 plan [13; pp. 78 and 80–81].

It is impossible to assign the British Museum fragments to Corridor 92 and Room 119 with complete certainty, since repetitive panels with similar motifs are found elsewhere in the complex. However, detailed study of the subject matter, shape and condition of the fragments compared with the frescoes remaining in these rooms suggests that these are indeed highly likely locations, especially the fluted half-dome of Room 119.

Condition before treatment

It is clear from Weege’s early images of the wall paintings that they had already been subject to significant interventive treatment to reassemble and mount the fragments [11; pp. 192–193, figs 38–40]. By the time they were examined for the Roman Empire exhibition, all 12 wall paintings were in a similar state of preservation, stable but extremely dirty. They generally consisted of multiple, re-joined fragments, with associated losses filled with painted plaster. Each fragment is set into a plaster mount and, in the case of fragment No. 2, the plaster was found to cover portions of the original surface. It is highly probable that the paintings were already set into these surrounds when they were purchased by the British Museum, as the letters speak of “about a dozen fragments”.
However, later additions and adjustments have been made to these earlier surrounds, probably when they were placed on display in the 1990s.

There is a slight white efflorescence on some areas of the wall paintings, possibly caused by a salt bloom associated with the setting of the paintings into the plaster surrounds, Figure 5. Similar blooms have, however, been observed on sections of the wall paintings remaining in situ [14; p. 1066, fig. 3]. Water damage, primarily the bleeding of red pigment into the white plaster background, was visible, particularly on those paintings connected to Room 119. A thick layer of varnish that obscures the colours and details of the original painted surface has been applied to all 12 fragments at some stage after the water damage occurred. Most of this varnish had been removed from several of the wall paintings, but six (Nos 2, 5, 6, 12, 14 and 16) remained completely covered. A discoloured wax-like substance was present on a number of the fragments and was clearly already discoloured when Weege’s images were made. The application of waxes and varnishes to wall paintings is quite typical of early conservation methods to consolidate and/or protect the surface [15]. Furthermore, white paint had been applied to fragment Nos 3, 12 and 13 in an apparent attempt to hide the water damage, but this paint displayed a flaky craquelure where it had shrunk back from the surface of the wall painting; despite this, the underlying original surface remained stable. No conservation records documenting any of these earlier treatments were found.

Conservation

A standard treatment strategy was developed to address, subject to spot-testing in each case, conservation concerns relating, primarily, to the dirty, discoloured varnish or wax layers and the overlapping of the edges of the plaster surrounds onto some parts of the original surface.

Nine of the 12 wall paintings have been conserved (Nos 2, 5, 6, 8, 10, 12–14 and 16), including all those in which a discoloured varnish covered the entire painting. While the varnish had helped to protect the paintings and made it easier to remove surface dirt, it significantly obscured the painted surface. Solvent testing determined that both acetone (propanone) and industrial methylated spirit (IMS) worked safely and effectively to remove the varnish without damaging the original surface. Acetone was selected for its volatility; as it evaporates more quickly than IMS this minimizes the risk to the porous painted plaster. The modern white paint covering the background of Nos 12 and 13 was only softened by acetone, while it could be removed effectively with IMS.

The wax was insoluble in all the solvents tested: acetone, IMS and white spirits. When used for wall painting conservation, waxes are often extremely difficult to remove because they are typically mixtures of different substances, rather than wax alone [15]. In areas where it was visually disfiguring, the thickness of the wax layer was reduced mechanically under the microscope. To reduce the risk of staining or softening
the original surface, this method was selected in preference to poulticing or the use – after testing – of stronger solvents.

The typical overall treatment comprised some or all of the following steps:

1. Surface cleaned with ‘smoke sponge’ (soft vulcanized latex rubber).
2. Modern paint (where present) removed with swabs soaked with IMS.
3. Varnished areas cleaned with cotton swabs slightly moistened with saliva.
4. Varnish (where present) removed with swabs soaked with acetone.
5. Surfaces with varnish already removed lightly cleaned with acetone swabs.
6. Wax (where disfiguring) reduced mechanically.
7. Areas of old plaster fills and surrounds overlapping the original surface reduced mechanically.
8. Damaged and friable areas of newly revealed surface consolidated with a 3% w/v solution of Paraloid B72 (ethyl methacrylate and methyl acrylate copolymer) in a 1:1 mixture of acetone and IMS.
9. Old fills resurfaced with glass microballoons suspended in a 20% w/v solution of Paraloid B72 in a 1:1 mixture of acetone and IMS; the open cracks were also filled with this mixture.
10. Fills retouched with acrylic paints.
11. Plaster surrounds repainted with emulsion paint.

The required fills were generally quite small and the form of the original composition clear. For wall painting No. 5, which it was intended to display after conservation, the fills were colour matched to give viewers a clear, undisrupted impression of the composition, particularly as there was no doubt in the reconstruction of the scene, Figure 6. Fills on the other fragments were matched to the off-white colour of the plaster background, since for some the reconstruction of the original colours and schemes was less straightforward.

Analysis of the gold leaf in 1983–1984 had indicated that it no longer adhered well to the original surface [1, 16]. The gold
had been lost in some places and it is likely that the varnish had helped to protect what remained. To lessen the risk of further loss to the gold leaf, the varnish overlying the gold was cleaned only lightly with acetone swabs to reduce the thickness of the varnish, rather than to remove it entirely. Areas of early graffiti were also avoided during solvent cleaning.

This conservation programme has helped to reveal the fine details of the original surface. Among its benefits, it has revealed more clearly the colours of the blue and green pigments, which were virtually indistinguishable before cleaning and removal of the varnish, Figure 6. Removal of areas of modern plaster overlying the original surface uncovered sections of modelled stucco that were previously hidden, most notably in Nos 2 and 14. After cleaning, two small sections of gold leaf were also discovered under the microscope on fragment No. 12, a painting that was not among those analysed in the 1980s.

**Scientific analysis**

**Methodology**

In 1983–1984, analysis of samples from a number of the wall paintings was conducted using a combination of X-ray fluorescence (XRF), X-ray diffraction (XRD) and scanning electron microscopy (SEM) [1, 16]. This revealed the presence of gold leaf and the pigments Egyptian blue and cinnabar. After consulting the documentation generated by these analyses, the paintings were re-examined in 2013 using optical microscopy and diffuse and raking light. These visual examinations revealed further distinctions between the paintings thought to belong to Corridor 92 and Room 119, particularly relating to the use of red pigments. Portable X-ray fluorescence (pXRF) was used to confirm and substantiate these observed distinctions. While this method has some limitations, revealing elemental composition (excluding the lighter elements) rather than molecular structure, it provided an efficient, non-destructive method for detecting heavier elements without requiring further sampling. Visible-induced luminescence (VIL) imaging was also conducted to determine the extent of the presence of Egyptian blue [17]. The results demonstrate differences between two sub-groups of wall paintings.

**Gilding**

In 1983–1984, XRD and XRF detected gold in five out of six samples (taken from Nos 2, 3, 5, 11, 13 and 14; Table 1) [1, 16]. When samples from fragment No. 2 were examined by SEM, the gold was found to be unusually thin, at approximately 0.4 mm; the production of such thin leaf would have required gold of very high purity. The 1980s investigations of fragment No. 13 were limited to the analysis of a small sample and failed to find gold. However, examination by optical microscopy in 2013 suggested that gold was indeed present, which was subsequently confirmed by pXRF. Two minuscule pieces of gold were also discovered under the microscope on No. 12, a finding corroborated by pXRF. The gold leaf had been applied both to areas of stucco relief (No. 5) and to numerous small areas to which a yellow pigment had first been applied, Figure 5. Analysis by pXRF indicated that this was an iron-rich pigment, probably a yellow ochre. Gold leaf was discovered only on the wall paintings attributed to Room 119.

**Pigments**

The wall paintings are dominated by blue, green and red pigments. After cleaning and removal of the aged varnish, the range of blue and green pigments present on the paintings became clear. These included: (1) deep blue; (2) bright green; (3) pale blue; (4) pale green; and (5) very pale, watery blue. Pigment types (1), (2) and (3) are quite coarse in comparison with the pale green and red pigments. In particular, types (1) and (2) consist of very coarse particles applied thickly in an impasto fashion. These were frequently applied on top of a black, probably carbon-based, underlayer, although carbon is too light an element to be detected by pXRF; in places this black was also used for outlining, Figure 5. A sample of the deep blue pigment (1) on fragment No. 2 was identified as calcium copper tetrasilicate (synthetic cuprorivaite: CaCuSi₄O₉) by XRD in 1984. This material is commonly known as Egyptian blue and was called caerulean blue by Vitruvius [18; pp. 15–21, 19; book 7 XI]. VIL imaging in 2013 showed the characteristic luminescence of Egyptian blue, supporting the earlier identification. This coarse form of Egyptian blue was present in all of the paintings attributed to Room 119, but only two from Corridor 92 (Nos 6 and 8). VIL imaging also revealed that the pale blue (3) and very pale, watery blue (5) are similarly composed of Egyptian blue. The former is limited to paintings from Room 119, while the latter is found only in the sea-monster paintings of Corridor 92 (Nos 1 and 10). Visual examination and optical microscopy demonstrated that these lighter shades were achieved by crushing the pigment to an increasingly fine powder. Although the pale blue remains rather coarse, it is much less than the darker blue, as Egyptian blue is known to lose its colour very quickly when it is ground [18; p. 24].

Roman fresco painters often achieved green by mixing Egyptian blue with yellow [20; pp. 1124 and 1132, 21]. However, VIL imaging showed that Egyptian blue was completely absent from both green pigments used, (2) and (4), Figure 7. The coarse, bright green pigment (2), which is visible only on the paintings from Room 119, has a glassy appearance under the microscope, similar to that of the deep, coarse Egyptian blue, Figure 5. Analysis by pXRF indicated that the green is a copper-based pigment and its frit-like appearance under the microscope suggests that it is likely to be Egyptian green. Other copper-containing pigments, such as malachite, cannot be ruled out, although it has been noted that malachite is incompatible with fresco technique [22; p. 139]. The pale green is found only on paintings designated to Corridor 92; the presence of iron, but complete absence of copper in this pigment, suggests that it is a green earth [23; pp. 180–181 and 254–255].

Analysis of the red pigment on fragment No. 2 by XRF and XRD in 1984 identified this material to be cinnabar (HgS), known to the Romans as minium (not to be confused with the modern use of the term minium, which refers to red lead) [10; book 33 LXXXVI, 23; pp. 111–112 and 270]. Analysis by pXRF showed that this pigment was widespread in all the paintings linked to Room 119 and that it had been thickly and generously applied. The pXRF results also show that all of the areas painted with cinnabar additionally contain iron- and lead-containing pigments, probably red ochre (iron oxide, Fe₂O₃, rubrica) and red lead (Pb₃O₄, minium secondarium).
respectively. The cinnabar in the British Museum paintings seems to have been protected to a certain extent by its interior context, but it may also be that the pigments found alongside the cinnabar were deliberately added to protect the cinnabar, as certain varieties of cinnabar are known to blacken in sunlight [24]. Scanning electron microscopy with energy dispersive X-ray analysis (SEM-EDX) of Roman wall paintings from the so-called Pinturas Báquicas in the Casa del Mitreo at Emerita Augusta (Mérida, Spain) has revealed that the cinnabar layer was covered with a thin film of iron oxide, which perhaps acted as a protective layer in a similar fashion [20].

Different mixtures of the three red pigments were used to achieve different shades in the paintings from Room 119. Red ochre always occurs, together with red lead, and increasing quantities of red ochre were added to produce the darkest shades of red, used for the bodies of the sphinxes present in several of the paintings (Nos 3, 5, 12 and 13). The reds are rather different on the wall paintings in Corridor 92; these are typically more thinly applied and of a brighter red-orange colour. Analysis by pXRF revealed that, with the exception of No. 8, there is no cinnabar in these paintings, but that the reds consist of red ochre and red lead, mixed in varying ratios, with a higher proportion of red ochre in the darker shades. The pale red/pink present on the sea monsters in fragment No. 1 (Figure 2) appears to consist only of red lead, while significant quantities of red ochre have been added to the darker red painted details.

**Plaster**

Analysis focused on the painted surface rather than the plaster substrate, the investigation of which would require more significant intervention. However, some features can be noted. Examination under raking light revealed incisions made to set out the composition in several of the paintings. Fragment No. 5 displays a number of parallel horizontal lines, as well as circular incisions made with a compass to position the open flowers, Figure 8. This setting out helped the artist to paint an evenly balanced composition and was particularly useful for the repetitive border motifs. The presence of these incisions suggests that the wall paintings were created using the fresco technique, with the pigments applied to fresh, damp lime plaster. The pigments are bound into the plaster as the lime undergoes a chemical reaction to form a film of calcium carbonate [25]. Fresco painting requires the artist to work quickly to apply the pigments before the plaster dries and the incisions will have assisted with swift painting.

The stability of this group of wall paintings, despite their fragmentary nature and likely burial after falling from the wall, is also indicative of fresco. Certain pigments, such as cinnabar and Egyptian blue, are more compatible with use in the fresco technique than others [22; pp. 138–140]. There is a limit to how thickly pigments can be applied in true fresco painting. Many of the paint layers present on the fragments are quite thick (frequently 1 mm or more), which suggests that a mixed technique may have been used in which slaked lime (calcium hydroxide) was added to the pigments to ensure
Figure 9. Detail of fragment No. 2 (Room 119) after conservation, showing the gilding applied to the flowers and fruit

Figure 10. Detail of fragment No. 14 (Room 119) after conservation. The scale bar shows 1 cm divisions

that the fresco-fixing process occurred throughout the pigment layer [14; p. 1061]. In addition, the gilding would also have been applied once the lime had hardened, probably with the assistance of a binder.

Summary of the findings

While all the wall paintings display fluidly painted floral motifs interspersed with miniature scenes of mythological and living creatures, close investigation has revealed that there are clear differences across the group, which largely correspond with their attribution to separate rooms.

The wall paintings designated to Room 119 show conscientious use of texture, light and shade. Stuccowork is employed primarily in the form of cornices, but the figures of Leda and the Swan in fragment No. 5 are also modelled, Figure 8. Shade and texture are provided by the coarse impasto of the deep blue and green pigments, the gold leaf highlights and the black outlines used in the exquisitely painted No. 5. The pieces of gold leaf are frequently rhomboid shaped and used to accentuate details of the composition, commonly the fruits and flowers of the stylized plants (for example, No. 2; Figure 9). Gold also highlights the crowns of the sphinxes in the mythological scene in fragment No. 5 and the wings of the swans in Nos 5, 12 and 14. The gold leaf is of the highest quality and the red pigment mixtures always contain cinnabar, combined with red ochre and red lead to achieve different shades. Cinnabar was Rome’s most expensive pigment and worth 10 times more than even high-quality red ochre [23; pp. 111–112]. Egyptian blue was used for all the shades of blue that were required, ground to different levels of fineness. Egyptian blue is regarded as the first synthetic pigment and was probably the most expensive pigment after cinnabar [18; p. 27]. The use of a copper-based green pigment, whether it be Egyptian green or malachite, is unusual as the most common green pigment in Roman wall painting was green earth. Copper-based pigments are rarely found [22; pp. 139–140, 26; p. 1821] and malachite is labelled by Pliny (who refers to it as chrysocolla) as one of the expensive ‘florid’ pigments, along with cinnabar [10; book 33 LXXXVI, 21].

The wall paintings attributed to Corridor 92 lack the finishing touches characteristic of those from Room 119, including the gilding and stuccowork. While the colour palette is similar, the pigments used tend to differ. Instead of cinnabar, the cheaper red ochre and red lead are more typically employed (with the exception of fragment No. 8) and the more common green earth replaces the copper-based green pigment. Egyptian blue is still found widely on these paintings, but this is not surprising, as it is the only blue pigment yet discovered on any Roman wall painting [26; p. 1818]. While the layers of dark Egyptian blue and green earth paint are as thick as those from Room 119, the red layers are thinner and the pale, watery shade of Egyptian blue used for the sea monsters is very thin, although the latter appears to be a firm stylistic choice. There is less differentiation in shades of colour. For example, while the red Medusa head in the centre of fragment No. 14 (Figure 10) and the sphinxes of No. 5 (Figure 6) – both attributed to Room 119 – are formed with brush strokes in different shades of red, the red used for the Griffin, sphinx and border of Fragment No. 6, from Corridor 92, is flat and uniform.

Interpretation: evidence for status

There are clear differences in pigment use between the paintings. With the exception of the Pegasus in fragment No 8, cinnabar, copper-based green and gilding are found only in the paintings from Room 119; even though the number of fragments considered in this study is relatively small, this cannot be a coincidence.

It is generally accepted that the rooms of the Domus Aurea were decorated according to status, depending on their intended purpose and occupants. Accordingly, rooms for entertaining high-status visitors obviously needed to be decorated differently from those that merely formed connecting routes for personnel and slaves. In the Roman period, marble wall panels were considered much more prestigious than paintings, and in the Domus Aurea four different decorative schemes are found. The rooms of lowest status had painted walls and ceilings, while those of highest status had marble-faced walls up to the level of a painted ceiling; the two intermediate levels had marble facing to different heights from the floor [27; vol. II, figs 0.12 and 0.13, 28].

Separately, studies of the painted decorations in the Domus Aurea based on their motifs and by stylistic and visual analysis have identified differences in painting styles between rooms. These range from very simple and crude schemes that were obviously quickly painted to the intricate and sumptuous. Stylistic differences have sometimes been attributed to different
workshops active within the Domus Aurea, and variations in quality to the abilities of individual master painters and their apprentices [27; vol. I, pp. 56–57]. While these are attractive theories, and there can surely be little doubt that several workshops must have been necessary for a palace as grand as the Domus Aurea, there is a lack of specific evidence for the existence of different workshops, other than that based on distinctions in style.

What is clear is that Room 119, one of the outward-facing and more public rooms, has ‘level two’ status, with marble panelling covering two-thirds of the height of the wall, while Corridor 92, a hidden corridor most likely used by servants, has the lowest (‘level four’) status and had no marble decoration. This distinction corresponds with both the visual and technical differences between the two sub-groups of wall painting fragments held at the British Museum. In the examples from Corridor 92, the motifs appear more hurriedly and plainly painted, and the paint itself was more thinly applied and based on less expensive pigments. This suggests that the choice of pigments was just as much an indicator of room status as the marble panelling. The less expensive pigments used for the wall painting fragments from Corridor 92 are indicative of its service function, while those of Room 119 demonstrate its more prestigious standing. It is possible, as Meyboom and Moormann hypothesize [27; vol. I, pp. 56–57], that these differences also represent the work of two or more workshops, but not necessarily; one workshop would have been capable of painting in different styles and sizes and also of using different motifs as required. What is unmistakable from the analyses reported here is that, regardless of the number of workshops involved, higher value pigments were specifically selected for the grander rooms.

Conclusions

Pigment analysis on 12 wall painting fragments, attributable to two different rooms of the Domus Aurea (most probably Rooms 92 and 119), shows the use of the same colour palette, but with the significant addition of three high-value pigments in the more elaborate paintings attributed to Room 119: cinnabar, copper-based green and gold. Visual differences in painting styles, as well as varying utilization of marble panelling, had already indicated a difference in status between the two rooms, but scientific analysis has further confirmed that the most rare and expensive pigments (even when they produced very similar colours to their more common counterparts) were specifically reserved for the higher status areas. It is clear, therefore, that the material choices owe more to the hierarchy of rooms than the possible presence of separate workshops, as the former prescribed not only the level of marble and presence of gilding, but also the finer elements of pigment selection.

Experimental appendix

Microscopy

In situ examination was carried out with a Leica MZ 9.5 microscope at a magnification of ×0.63 to ×6.0. Images at a magnification of ×20 were made using a Veho VMS-004 Discovery Deluxe digital USB microscope.

Visible-induced luminescence imaging (VIL)

The VIL images of fragment 1908,0417.5 were made with a Canon 40D camera body, from which the inbuilt IR-blocking filter had been removed, fitted with a Schott RG830 cut-on filter; excitation was provided by red LED light sources. The remaining fragments were imaged using a Fujifilm IS Pro camera body, again with the inbuilt IR-blocking filter removed, fitted with an IR950 filter; excitation was provided by white LED light sources.

Portable X-ray fluorescence (pXRF)

Data were collected using an Innova X/Olympus Delta Premium pXRF with a silver tube, operating at up to 40 kV. Both alloy and soil analytical modes were employed and spot measurements with a diameter of 3 or 10 mm were made.

Materials and suppliers

• Paraloid B72, glass microballoons and ‘smoke sponge’: Conservation Resources (UK) Ltd, Unit 2, Off Waattington Road, Cowley, Oxford OX4 6TU, UK.
• Acetone, IMS and white spirits: VWR International Ltd, Hunter Boulevard, Magna Park, Lutterworth, Leicestershire LE17 4NN, UK.

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References

3. Department of Greek and Roman Antiquities, BM Reports 1907, 1908, British Museum, London.

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Notes

1. In the catalogue by Hinks [29], the fragments were published as Paintings 55 A to L under the now obsolete registration system.

2. For reference, similar and nearly identical motifs to those on the British Museum fragments can be found in publications on the Domus Aurea. For Corridor 92, compare: figure 23 in Dacos [30] with fragments 1 and 10 (and figure 26 with fragment 1); figures 63–64 in Segala and Sciortino [31] with fragment 8 (and figure 30 with fragment 16); figure 92.20 in Meyboom and Moormann [27; vol. II] with fragment 1; figures 30, 42 and 43 in Weege [11] with fragment 6 (and figure 27 with fragment 16).

3. For attribution of the remaining fragments to Room 119, see Dacos [30; p. 15], reiterated by Salmon [12; p. 84 and note 57] and Meyboom and Moormann [27; vol. I, p. 229 and note 278]. For images of similar motifs, compare: figure 3 in Dacos [30] with fragments 2, 3, 5 and 13 (and figure 10 with fragments 3 and 12–14); figures 1 and 63 in Iacopi [32] with fragments 3 and 13 (and figure 65 with fragment 3); figures 119.9 and 119.11 in Meyboom and Moormann [27; vol. II] with fragments 3 and 12–14.

4. Furthermore, two fragments in the Musée du Louvre, said by Meyboom and Moormann to come from Room 119 [27; vol. II, p. 229 and note 278], originate from Corridor 92 [33].

5. Bianchi Bandinelli considers the paintings to be the products of two workshops [34], a view also expressed by Paradisi et al. [14; p. 1061]. Meyboom and Moormann have more recently suggested three workshops [27; vol. I, pp. 54–64].